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## A STANDARD ACCIDENT TABLE AS A BASIS FOR COMPENSATION RATES.

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The rapid growth of compensation legislation in this country has created a sudden demand for accident statistics which the American statistical literature was utterly unable to meet. The majority of American compensation acts are based upon private compensation insurance which may be solvent only when based upon accurate premium computations. The German method of assessment insurance for industrial accidents can only be successful when built upon a compulsory organization of the insurance carrier. This method has been followed in a few states only, notably Washington and West Virginia. The difficult problem of calculating proper rates for compensation insurance, rates which should not be excessively high and yet sufficient to meet all the slowly developing charges resulting from accidental injuries, found the business of casualty insurance somewhat unprepared. The development of compensation legislation was so precipitated and so unexpected that there was little time to prepare the necessary material.

As compensation was a substitute for the discredited system of employer's liability, so insurance of the obligations created by compensation acts developed out of the methods of employer's liability insurance. Naturally enough the casualty companies (that is the insurance companies writing so-called miscellaneous lines, including almost all lines outside of life, fire and marine, liability insurance being the most important of these) were forced to rely upon the experience under liability insurance for making hurried estimates as to the probable cost of accident compensation. It became evident very soon that the two systems were entirely different, not only from the point of view of social justice, but also from that of insurance practice. The experience under one was of little

service in shaping methods for the conduct of the other branch of insurance. For the benefit of statisticians not familiar with the conditions of employer's liability insurance these may be briefly stated here:

An employer's liability insurance contract obligates the insurance company (for a certain consideration stipulated in advance and known as the premium) to reimburse the insured employer in case he is called upon to pay damages for accidental injuries sustained by his employees in accordance with the verdict of a court. In practice the insurance company, in order to reduce the possible losses through such court verdicts, undertakes to defend the suit and also endeavors to settle amicably out of court as many suits, or claims threatening to become suits, as possible. Naturally, the losses, while depending upon the frequency and severity of the injuries sustained, do not at all bear any definite relation to them. Perhaps in an equal degree they depend upon the stringency of the liability legislation of each particular state, upon the nature of the court decisions as to the validity of the "Three Defenses," upon the skill of the attorneys in defending suits and arguing appeals, and upon the efficiency of adjusters to settle a large number of claims before the injured employees are tempted to bring suit against the employer.

In compensation insurance the cost in any one industry evidently depends entirely upon the number and character of the injuries occurring in that industry, as well as upon the amount of compensation granted by the particular law. Under employer's liability laws there frequently is no logical or equitable relation between the character of the injury and the cost of settlement. Very much more depends upon the existing legal evidence as to the cause and the manner of occurrence of the accidents. For this reason the legal features of the cases are much more carefully studied than their surgical or medical features. Every large casualty company had some sort of a statistical organization even before the advent of compensation legislation, but the statistical work done approached the problem from a different point of view. The experience studied dealt largely with the relations between money losses paid and premiums collected, or the exposure in

dollars of pay roll, so as to obtain either the loss ratio or the so-called pure premium.\*

Very seldom were the accidents reported studied, and almost never were their physical nature or their economic effect upon the earning capacity of the wage-earner considered.

This experience for numerous minute subdivisions of industry was almost the only available source of information upon which to build compensation rates. No wonder then that the rates at first proposed were in the nature of guesses only, and many of them went far beyond the mark. An effort was made by the central rate-making organization of the casualty companies to utilize the experience of the so-called workmen's collective insurance.† This is a form of insurance more closely approaching workmen's compensation because it covers employees of certain establishments for all accidental occupational injuries irrespective of fault, and the benefits are subject to a definite schedule, though very much more limited than any schedule of benefits under compensation. The records of this form of accident insurance, had they been properly kept and had there been enough of them, would have presented very valuable information as to the number and nature of accidents in separate industries. Unfortunately the volume of this business available to the rate-making bureau was much too small, perhaps a paltry \$100,000,000 of wage exposure, equal to some 200,000 employees working for one year. This amount, divided into many different industries, leaves very little to depend upon for most independent industries. Besides, the actual records were very far from satisfactory as to the nature of the injury and duration of disability. Instead of the accident experience under these collective policies, their loss experience was utilized as a starting point and the rates charged for

\* By loss ratio is meant the percentage proportion between losses and premiums. By pure premium is understood the cost of losses per hundred dollars of wages paid by the insured employer to his employees. This method of computation, as well as the reference of all computations to the exposure of wages paid rather than persons employed, is unsatisfactory from the point of view of theoretical accident statistics, but is explained by the conditions of the business. Ideal accuracy would undoubtedly require that the number of employees and the time spent in work be computed, but there are so many practical difficulties in the way of accurate determination of these facts by thousands of independent employers that the rough and ready measurement of the risk by the volume of pay roll in practice presents much more accurate results.

† See article, "Establishing Rates for Workmen's Compensation," by Theodore E. Gaty, *Market World and Chronicle*, January 11, 1913.

insurance under that form of contract. But as these rates were originally computed from very limited data, the building could not be stronger than the foundation. There is no doubt that the dissatisfaction of employers with the conduct of compensation insurance during the first experimental years was largely caused by the absence of accurate data from which scientific rates could have been built.

The question has often been asked why the voluminous and carefully studied accident statistics of European countries has not been utilized at this critical moment. Germany, for instance, having begun insurance against industrial accidents nearly thirty years earlier, possesses almost a library of statistical material on this problem. There were several reasons why that experience was not and could not have been utilized.

To begin with, a widespread feeling of skepticism in regard to all European experience may often be found even among students of social conditions, and is especially strong among practical American business men. While in life insurance mathematically accurate data have been in use for many decades, casualty insurance is still managed very largely as a business and very little as a science. Knowledge of foreign statistical sources among casualty men, with a few notable exceptions, was rare. It was easy to argue that European statistics were utterly inapplicable because, as everyone would readily admit, our own industrial activity is so much more hazardous, accident prevention less known, factory inspection less efficient, and for these reasons the number of industrial accidents is very much greater. Moreover, the various European compensation acts are quite different from each other, especially in their provisions as to the prescribed scales of compensation, and the American acts still more different from the European acts, and unfortunately, from each other.

Furthermore, European accident statistics are published and studied according to many different methods. Efforts to establish a uniform system of accident statistics in Europe though advanced by the International Statistical Institute have not as yet been successful. The definition of what constitutes an accident, the distribution of accidents into groups according to their surgical and economic results (that is as to

the physical nature of the injury and as to its effects upon the earning capacity of the victim) the classification of industries used, etc., all this is different in every known statistical source. Finally, the statistics published are in such a form as to be much more useful for general social purposes than for the computation of rates. It may be very instructive to know that the accident frequency in the metal working industry is 50 per cent. higher than in the woodworking industry, but the insurance carrier does not undertake to insure either the one or the other. Insurance must be written and rates quoted for certain industrial establishments manufacturing definite articles or for contractors performing definite jobs, and no European source presents its data in sufficient detail to meet the demands of the practical casualty underwriter for specific information in regard to some 1,500 different classifications of industrial undertakings. All this explains why it is impossible to draw directly upon European sources for the necessary information. Does it follow, therefore, that all European experience is altogether worthless to help meet the difficulties arising out of the application of compensation acts in this country during the first few years?

In an article published early in the history of compensation\* the writer suggested a method for computing compensation rates by means of utilizing all possible American and European statistics. The method suggested may be outlined by means of the following quotations:

All scientific rates must include the following three elements: first, agent's commissions; second, expenses of central administration; third, the pure cost or pure premium. In the matter of workmen's compensation in the United States, the first two of these items depend entirely upon American conditions, and are easily controlled and computed. All the uncertainty, all that is still obscure, lies in the third item—the factor of pure cost or pure premium.

Now, the pure premium itself may be resolved into three factors: first, the accident rate; second, the proportion of the various classes of accidents (that is as determined by degree of disability, duration of disability, etc.), to the whole number of accidents; third, the compensation scale to be used.

\*Arriving at the Cost of Workmen's Compensation in the United States, *Market World and Chronicle*, June 22, 1912.

Summarized, the plan calls for the following operations: first, determine the rates of accident in the various industries on the basis of American experience; second, determine the relative proportion of fatalities of permanent disability cases, partial or total, and the relative duration of temporary cases, on the basis of European experience; third, apply to the results thus obtained through the combination of American and European experience the various compensation scales of the various American compensation laws.

The first suggestion outlined above, as to what may be termed accident frequency, had in view a possible utilization of the many thousands of accident reports transmitted to the casualty companies by their policy holders. For a careful study of accident statistics these reports are of little value because of their faulty character, but it did seem to the writer that the simple count of these reports for each separate industry might give a sufficient indication of relative accident frequency.

The most important part of the plan is contained in the second suggestion that European experience might be utilized for the purpose of distributing accidents into groups according to gravity. This suggestion has found enthusiastic support among some actuaries and insurance statisticians, while it has been severely criticized by others. One may perhaps be excused for stating this suggestion in the terms originally used:

It is when we come to the proportion of the various classes of accidents that we meet with the greatest difficulties for here we have almost no available American experience at all . . . we must look for light elsewhere . . . until we have gone far enough with workmen's compensation in the United States to have our own experience. . . . As regards this problem of the nature and effects of injuries . . . there can be no great differences between one country and another. An examination of the statistical material of various countries shows that there is practically no variation from country to country. It appears that whatever its nationality, the human machine is a human machine, and that its average resistance to injury and its average speed of recovery from injury vary very little.

As regards the first suggestion that the accident frequency of various branches of industry be ascertained from all records of casualty companies dealing with liability insurance, it has

never been practically utilized. With the rapid accumulation of experience under compensation insurance, the necessity for making use of this method is passing away. While the failure of the casualty companies to make use of the plan proposed seems unfortunate because it might have prevented many errors, this at present is a matter of purely historic interest.

The second suggestion as to the method of studying accident gravity was destined to play a more important part in the development of compensation legislation and insurance. Though extremely simple in itself and almost obvious to anyone who has made any study at all of foreign accident statistics, it appeared like a new scientific clue to many actuaries who were groping for some practical method of computing the cost of compensation. It was impossible to make any direct comparisons between the American compensation scales and those of Germany or France and determine in that way the relative cost of the different acts. The differences in the scales were so many that it was necessary to weight each difference in these provisions in accordance with the frequency with which it might come into play, and the comparative share of each group of accidents in the total cost of all.

As far as the writer's information goes, Professor A. W. Whitney, at that time consulting actuary of the California Industrial Accident Commission, was the first to make use of the above suggestions, and apply a hypothetical distribution of accidents based upon European experience to this problem, to determine the probable cost of the proposed California Acts as compared with the then California Act and with other acts in existence at the time.\* Another Californian student of the problem, Mr. A. H. Mowbray, a consulting actuary who was chairman of the Social Insurance Committee of the Commonwealth Club of San Francisco, has also applied this method to a comparison of the proposed California Act with the existing Illinois and Massachusetts Acts.† Mr. Mowbray made a careful analysis of the statistics of various countries as pub-

\* See "Memorandum concerning a proposed scale of Compensation Benefits to be paid to Workmen injured through industrial accident now under consideration by the Industrial Accident Board of California," 1912.

† See a typewritten memorandum, entitled "A Suggested Basis for the Determination of Comparative Costs of Different Compensation Schedules, and Some Comparisons thereof."

lished in the twenty-fourth Annual Report of the United States Commissioner of Labor, and concluded that "the close agreement" between these various statistical data "seems to strengthen the case in favor of Mr. Rubinow's hypothesis."

Thus the plan outlined above was never used in its entirety for the purpose of computing compensation rates, but it proved to be quite adaptable to the specific purpose of ascertaining the difference in the cost of different compensation acts, or what may be called a differential between different acts.

While the efforts of Professor A. W. Whitney and Mr. A. H. Mowbray were of theoretical importance only and did not serve as a basis for rate computation, the first practical application of the method occurred in connection with the New York Compensation Act, passed by the New York Legislature in December, 1913, to go into effect July 1, 1914. The act conferred upon the New York Insurance Department the duty of passing upon the adequacy of the rates to be charged for compensation insurance. The declared purpose of this legislation was to protect the policy holders as well as the injured employees against the possible danger of insolvency of the insurance carriers, which might result from inadequate rates. In order to act intelligently under the new power conferred upon it, the insurance department faced the problem of establishing some standard measure of rate adequacy at the time the New York Compensation Act, different from all other acts and more generous than most of them, was going into effect. The problem appeared extremely difficult, almost insolvable. A comparison with the rates in force in other states at the time did not seem helpful, since these rates were subject to many criticisms. Fortunately, the Insurance Department of Massachusetts, which had called upon the insurance companies early in 1914 to furnish results of compensation insurance in that state, was able to prepare the experience (that is, the relation between losses sustained, premiums received, and the wage exposure) on some \$500,000,000 of wages by separate industrial classifications. Thus some basis for calculation of pure premiums was available. The rate-making bureau of the casualty companies agreed to utilize this volume of experience in computing New York rates.

The writer was consulted by the actuaries of the New York Insurance Department and was asked to suggest a method for comparing the cost of the two acts. The method suggested embodied the principles above outlined, that is, a separate valuation of a given series of accidents, reflecting the normal distribution according to gravity, under both acts, and the comparison of the resulting cost. By a happy coincidence the preliminary results of the tabulation of industrial accidents in Massachusetts for the first year of operation of the compensation act (July 1, 1912, to June 30, 1913), made by the Industrial Accident Board of that state, also appeared at the time. The 90,000 accidents reported in Massachusetts were therefore used as a basis for the computation.

The problem assumed the following form: how much would these 90,000 accidents cost according to the Massachusetts law and how much according to the New York law, a proportion between the two amounts being the true differential between the laws of the two states.

But while the Massachusetts report was extremely useful, it did not analyze its material in sufficient detail to enable one to compute the cost accurately. Especially was the report unsatisfactory in regard to the question of permanent partial disability, the number of such cases, and the degree of disability resulting. As the New York Act is extremely liberal in regard to such cases, they represent a very substantial part of the entire cost of compensation, and some conception as to their number and gravity was absolutely necessary. For this purpose very detailed figures of Austrian and German accident statistics (analyzed in the twenty-fourth Annual Report of the United States Commissioner of Labor) were recommended. This was perhaps the first formal application of European experience to American compensation insurance.

The discussions accompanying the adoption of the New York compensation rates emphasize the great necessity of some scientific method for computing such rates for all compensation states. In most other states where compensation acts were in operation grumblings were heard against exorbitant and inequitable rates. Comparisons of rates in different states for identical industries were made by industrial accident

boards as well as private employers, and justifications for the differences disclosed were urgently demanded. The difficulties created by the co-existence of so many different acts were obvious. Not only did this make the work of preparing rates for each state so much more difficult, but it also vitiated comparisons of experience unless some method of equating these differences were applied.

To Professor A. W. Whitney (who became general manager of the Workmen's Compensation Service Bureau early in 1914) credit is due for the plan of bringing the insurance rates in all compensation states into harmony through a proper system of differentials instead of trying to prepare an independent schedule of rates in each state on the basis of its own experience.

Systems of state differentials were not altogether new in casualty insurance. They had been in use for a time in connection with employer's liability insurance. But while the old system of state differentials was largely a result of underwriting judgment (as to the comparative stringency of liability laws and as to the general conditions in various states) Professor Whitney's plan presupposed a scientifically accurate objective method of computation.

For the purpose of devising such a method a committee of casualty insurance experts was appointed by Professor Whitney.\*

It was agreed that the method of computing costs of a given number of accidents, as advocated by the writer, promised the most satisfactory results. Instead of trying to depend upon the unsatisfactory accident statistics of any one of the American states or foreign countries, it was decided to establish one definite standard schedule of distribution of accidents according to gravity of the result, or in other words, to construct something akin to the standard mortality table in life insurance. This first step necessary for the computation of differentials was entrusted to the writer. The study which follows was prepared in response to this demand. As far as the writer is aware, it is the first effort of its kind ever made in

\* This committee consisted of Mr. B. D. Flynn, Assistant Secretary of the Traveler's Insurance Company of Hartford, Conn., Mr. Stanley L. Otis, Actuary of the Workmen's Compensation Service Bureau, Mr. C. E. Scattergood, Assistant Secretary of the Fidelity & Casualty Company, and the writer for the Ocean Accident & Guarantee Corporation.

the domain of accident statistics or compensation insurance. It has been adopted by the committee mentioned above, whose work received the unanimous approval of the Workmen's Compensation Service Bureau, and it lies at the foundation of almost all compensation insurance rates at present in force in this country.

#### DEFINITION OF AN ACCIDENT.

In endeavoring to use European statistics and especially to compare the data of one country with those of another, the first serious difficulty is that arising out of the differences in regard to the definition of what constitutes an industrial accident. Reports on accident statistics have been strongly influenced by the provisions of compensation laws. In fact, there were scarcely any satisfactory accident statistics in any country previous to the enactment of compensation acts. There are, however, many differences between compensation acts as to the kind of accidents covered by their provisions. Several acts leave the care of minor accidents to other co-existing institutions, especially where a well organized system of sickness insurance is found. Thus, to quote the best known illustrations, in Germany all accidents for the first thirteen weeks, and in Austria those for the first four weeks, are left to the care of sick benefit funds. Naturally, only those accidents come under the compensation system which result in losses extended beyond this minimum period. In other countries injuries lasting less than a certain minimum length of time are left uncompensated altogether. In most cases the published accident statistics disregard accidents which do not extend beyond this so-called waiting period. Thus, German accident statistics cover only accidents leading to death, permanent disability, and temporary disability of over thirteen weeks. In Austrian statistics, accidents leading to temporary disability under four weeks are excluded; in Italy, those under five days; in Russia, those under four days; in France, under three days, etc. Evidently, since the number of such minor accidents is very large, the percentage of all classes of serious accidents whether resulting in death or permanent disability, etc., will depend very much upon how many of those small

accidents are included, or in other words, will depend entirely upon the accepted definition of an industrial accident.

This difficulty does not necessarily make European data useless, but it requires an adjustment before comparisons are made, so that before the figures of any country are to be used, all accidents which do not come under the uniform classification must be eliminated, and on the other hand, for such countries as Germany and Austria where the definition of an accident is very narrow, the figures must be adjusted by means of some factor to compute the probable number of accidents under the uniform definition.

Only after such adjustments are made does the principle hold true that the distribution of accidents according to gravity and consequences is fairly uniform in all countries. This is well illustrated by the following example showing the comparative distribution of 42,063 accidents treated by the Leipzig sick fund and 154,926 accidents occurring in Russia for the three-year period, 1904 to 1906:

Classes of Accidents.	Germany.		Russia.	
	Number.	Per Cent.	Number.	Per Cent.
Under 4 weeks.....	32,235	76.16	113,353	73.13
4 to 13 weeks.....	7,618	18.58	32,896	21.28
Over 13 weeks.....	1,968	4.68	7,596	4.90
Fatal.....	242	.58	1,081	.69
Total.....	42,063	100	154,926	100

A comparison of the figures in the above table seems to indicate a certain substantial difference between the distribution of accidents in the two countries compared. As a matter of fact, the difference is that in the German sick funds a good many minor cases have been reported which have been eliminated from the Russian statistics because of their duration being under four days. This reduces the total number of accidents but increases the percentage for the classes over four weeks, over thirteen weeks, and fatal, at the same time reducing the percentage of accidents under four weeks. These figures are here computed on a basis of one fatal accident. We find the following series expressed in multiples of the number of fatal accidents:

	Leipzig.	Russia.
Fatal accidents.....	1	1
Over 13 weeks.....	8	7
Over 4 and under 13 weeks..	31	30
Under 4 weeks.....	133	105

This clearly indicates the remarkable similarity between the statistics of the two countries except for the group of accidents of under four weeks' duration, where the material difference is explained by the considerations stated above.

The definition decided upon is identical with that accepted by the Statistical Committee of the Workmen's Compensation Service Bureau for the study of accident statistics of the casualty companies; namely, only such accidents are to be counted and studied which disable the injured employee for any time other than the day of injury. The same definition was accepted by several conferences of officials of bureaus of labor and by the American Association for Labor Legislation, and promises to become the standard definition of an industrial accident in the United States. It is practically equivalent to excluding accidents leading to disability of less than one day, because the injured person who does not return to work in the beginning of the day after the injury, is not likely to return at any time during that day.

This definition of an industrial accident is very much broader than that used in most governmental studies of accident statistics. However, a precedent may be found in the statistics of accidents to employees of the United States Government recently published.\*

There are practical reasons for selecting this definition. Even under liability insurance conditions, casualty companies were insistent that the minor injuries be carefully reported because the most trivial injury occasionally developed into a substantial claim or suit. The accident reports, or "notices" as they are technically designated, have been much more numerous than accidents of sufficient gravity. A narrow definition of "accident" would have entirely destroyed this basis of underwriting experience.

\* See *Compensation for Injuries to Employees of the United States Arising from Accidents Occurring between August 1, 1908, and June 30, 1911*, published by the Department of Commerce and Labor, Washington, 1913.

Certain difficulties are created by this definition because there is very little statistical material available to indicate the number of these minor accidents, and adjustments of almost all data become necessary. For the purpose of such adjustment, use was made of the statistics of injuries to United States employees, as explained below.

#### FIVE GROUPS OF ACCIDENTS.

Having accepted the standard definition, the problem is to ascertain the following relations:

First—The relative number of fatal accidents.

Second—The relative number of permanent total disability cases.

Third—The relative number of dismemberments and their character.

Fourth—The relative number of permanent partial disability cases and their distribution by degree of disability.

Fifth—The relative number of temporary disability cases and the distribution of such cases according to duration.

While it would be quite practicable to deal in percentages extending the figures to any necessary degree of accuracy, it seemed preferable to assume a standard total sufficiently large to permit of all necessary sub-divisions and yet not so large as to appear quite fanciful. The number of 100,000 was decided upon since in many of the larger states that many industrial accidents will occur in a year or two. The advantage of such a large base is that in the computations individual cases are dealt with and not fractions of cases.

The above division into five groups is necessitated partly by the nature of the problem and partly by the peculiarities of the American compensation acts. There is a very fine line of demarcation between permanent partial disability and permanent total disability, but an independent determination of the latter cases becomes necessary because special provisions for them are made in most American acts. Still more important is the treatment of cases of dismemberment by specific benefits in American acts, instead of considering the proportion of earning capacity lost, which is the European method. Of these five sub-divisions, some are due to definite physical

facts, so to speak, and not dependent upon differences in interpretation of the law. This includes fatal accidents, the number and character of dismemberments, and perhaps the distribution of temporary disability cases according to duration. On the other hand, when we deal with cases of permanent partial disability, and especially their distribution by degree of disability, we are dealing with facts which are largely influenced by differences in interpretation of law, and here the largest variation between one country and the other may be expected. In utilizing the statistics of foreign countries for the purpose of computing each one of these five groups of accidents, different checks and tests must therefore be introduced.

#### FATAL ACCIDENTS.

The experience of Massachusetts for the first year of the application of the Compensation act, as reported by the Industrial Accident Board, gives 474 fatal accidents out of the total of 90,168, or some 525 per 100,000. The Massachusetts report has no definition of accidents but counts all accident notices received. The following figures indicate the importance of adjusting the accident definition for the purpose of obtaining the percentage of fatal injuries:

#### PERCENTAGE OF FATAL ACCIDENTS IN VARIOUS COUNTRIES.

Massachusetts (1912-1913)—0.5 per cent. of all notices.

Leipzig Fund (1887-1903)—0.6 per cent. of accidents of over three days' duration.

Russia (1900-1906)—0.7 per cent. of accidents of over four days' duration.

Italy (1902)—0.75 per cent. of accidents of over five days' duration.

Austria (1897-1901)—4.1 per cent. of accidents of over four weeks' duration.

Germany (1899-1908)—8.4 per cent. of accidents of over thirteen weeks' duration.

In not a single instance do we find a definition of "accident" which would correspond to the one adopted here. To make the Massachusetts data conform to this definition, it is necessary to eliminate from the 90,168 notices those accidents where

duration of disability did not last over one day. Their number is not stated in the report, but it is indicated in a diagram that in 41 per cent. of all non-fatal accidents the disability did not last over one day:

$$90,168 - 474 \text{ fatal accidents} = 89,694 \text{ non-fatal accidents.}$$

$$89,694 \times .41 = 36,774 \text{ accidents of not over one day's duration.}$$

Deducting these, the total number of accidents in Massachusetts in 1912-1913 is reduced from 90,168 to 53,394, and the 474 fatal accidents constitute 0.888 per cent., or 888 per 100,000 accidents.

Before these figures are accepted, comparisons with a few other countries are necessary. In Austria from 1897 to 1901 there were 3,871 fatal accidents out of a total of 95,269 accidents of over four weeks' duration. To adjust this to our standard American definition of an "accident" the following method may be used:

According to the report on accidents among United States employees for 1908 to 1911, the 20,835 accidents were distributed as follows:

Duration.	Number.	Per Cent.
1 to 7 days	7,482	35.9
7 to 14 days	3,753	17.0
15 to 28 days	4,238	20.3
All other	5,362	25.8
 Total	 20,835	 100.0

As accidents of over four weeks' duration constitute 25.8 per cent. of all accidents of over one day's duration, we may assume that the 95,269 accidents of over four weeks' duration in Austria correspond to  $95,269 \div 25.8$  per cent. = 369,260 accidents of over one day's duration, on which basis Austria shows 1,048 fatal accidents per 100,000.

For a period of ten years the German industrial accident associations reported 54,166 fatal accidents out of a total of 642,344 accidents of thirteen weeks' duration, the fatalities constituting 8.43 per cent. Again, the United States statistical report referred to above indicates that accidents of over

thirteen weeks' duration constitute only 8.89 per cent. of all accidents of over one day's duration. The number of accidents of over one day's duration in Germany for the ten years would be equal to  $642,344 \div 8.89$  per cent. = 7,225,460, and the number of fatal accidents per 100,000 would be 750. In Italy a report for 1902 shows 430 fatal accidents out of a total of 57,617 accidents of over five days' duration, or 746 per 100,000. In Russia for a period of three years there were 2,345 fatal accidents out of 299,874 accidents of over four days' duration, or 782 per 100,000. In both these latter cases the true average would be somewhat smaller if all the petty accidents had been included. The United States report shows 670 fatal accidents out of a total of 20,835, or 3,216 per 100,000, which is evidently too high a figure explained by the very hazardous nature of the occupations covered by the Act of 1908. Averaging the fatal accident frequency in only four countries, Austria, Germany, Italy, and Russia, where a fairly general distribution of industries and occupations obtains, the average is 837 per 100,000, which is not very far from the Massachusetts figure of 888. In accepting the latter figure, it must be remembered that the Massachusetts report was prepared very soon after the completion of the year. Experience in Germany has demonstrated that within four or five years the number of fatal accidents increases by about 5 per cent. because of the subsequent death of many injured persons whose injuries originally did not appear to be fatal. Loading, therefore, the accepted figure by 5 per cent., we arrive at 932 fatal accidents per hundred thousand injured.

#### DISMEMBERMENTS.

Because most American acts contain specific schedules of benefits for cases of dismemberment, it is necessary to make an estimate of their number as well as the distribution among different kinds of dismemberments. As these cases are not treated in that fashion under the European compensation acts, comparatively little information is available. The best is that contained in the Austrian report for 1897 to 1901, which is the only source for exact data as to distribution of as large a number as 8,686 cases of dismemberment according to the exact nature of the loss sustained in each case.

Some test is necessary to establish how far the proportion of dismemberments differs, if at all, from such American experience as we have. The Massachusetts report shows 967 dismemberments out of a total of 90,162 accidents. To make this comparable with the Austrian figures, all accidents of under four weeks' duration must be eliminated, leaving only 11,237 accidents of over four weeks' duration. Dismemberments constitute 8.6 per cent. of that number. Of the Austrian 8,686 cases, 109 resulted fatally, leaving 8,577 cases, which in proportion to the 95,269 accidents of over four weeks' duration is 9 per cent. As Austrian figures are more complete because a certain number of cases must lead to amputation some time after the original injury has been sustained, it is felt that the Austrian and Massachusetts figures on that point are sufficiently comparable to permit the use of the Austrian figures. The experience from Michigan as reported in the *National Compensation Journal* of June, 1914, for six months, December 1, 1914, to May 31, 1914, gives 318 dismemberments and 6,046 cases of temporary disability, giving a proportion of about 5 per cent. But the Michigan report includes all accidents of over two weeks' duration. As the number of accidents of from two to four weeks' duration is approximately equal to the number of accidents of over four weeks' duration, it would indicate that cases of dismemberment in Michigan amount to about 10 per cent. of all the accidents of over four weeks' duration, which is even higher than the Austrian figures. Therefore, on the whole, the Austrian figures may be accepted. In the following statement is given a classified list of dismemberments occurring in Austria within the period specified, and also the number per 100,000 on a basis of all accidents of one day's duration or over, for which purpose the 95,269 accidents of over four weeks' duration were assumed to represent 369,260 accidents according to our accepted definition.

Kind of dismemberment.	Number of cases in Austria, and whether resulting in permanent dis- ability or not, but exclusive of cases resulting fatally.	Number per hun- dred thousands on an assumption of 369,260 cases.
1. Loss of left arm.....	239	65
2. Loss of right arm.....	352	95
3. Loss of left hand.....	183	50
4. Loss of right hand.....	225	61
Loss of entire fingers, two phalanges or more:		
5. Loss of left thumb.....	106	29
6. Loss of right thumb.....	114	31
7. Loss of left index.....	219	59
8. Loss of right index.....	255	69
9. Loss of left middle finger.....	96	26
10. Loss of right middle finger.....	116	31
11. Loss of left ring finger.....	51	14
12. Loss of right ring finger.....	63	17
13. Loss of left little finger.....	118	32
14. Loss of right little finger.....	127	34
15. Loss of thumb and one or more fingers, left hand.....	51	14
16. Loss of thumb and one or more fingers, right hand.....	62	17
17. Loss of two or more fingers, left hand.....	232	63
18. Loss of two or more fingers, right hand.....	245	66
Loss of one phalange of finger:		
19. Loss of left thumb.....	203	55
20. Loss of right thumb.....	228	62
21. Loss of left index.....	307	83
22. Loss of right index.....	343	93
23. Loss of left middle finger.....	191	52
24. Loss of right middle finger.....	194	53
25. Loss of left ring finger.....	91	25
26. Loss of right ring finger.....	71	19
27. Loss of left little finger.....	66	18
28. Loss of right little finger.....	62	17
29. Loss of fingers accompanied by injuries of other fingers of the same hand, left.....	637	172
30. Loss of fingers accompanied by injuries of other fingers of the same hand, right.....	638	173
31. Loss of one leg.....	475	129
32. Loss of both legs.....	11	3
33. Loss of toes.....	209	57
34. Loss of one eye.....	1,718	465
35. Loss of one eye with injury to the other.....	228	62
36. Loss of both eyes.....	51	14
Total dismemberments.....	8,577	2,323

#### PERMANENT TOTAL DISABILITY.

Specific provisions for compensation of cases of permanent total disability are found in many compensation acts differing materially from provisions for permanent partial disability. In many states life pensions are granted for the permanent total cases where only temporary limited benefits are given for permanent partial disability. While cases of this nature are few, the cost must be a material factor as compared with the total cost of compensation. Therefore, some estimate as to the probable number of such cases becomes necessary.

Here foreign material must be used with extreme care because it is a condition largely depending upon the interpretation given to the term. In some cases there can be no difference of opinion as to the existence of permanent total disability. In others, however, it will largely depend upon the liberality with which compensation acts are administered. No American data on the subject exist, and the European data show considerable fluctuations. The percentage of cases of permanent total disability in official reports fluctuate between .06 per cent. in Italy and 1.51 per cent. in Austria. To a large extent this difference, as already explained, is due to the differences in the definition of the word "accident," and the number of minor accidents excluded. To obtain a basis of comparison without the necessity of adjusting all figures to one uniform basis of an accident of over one day's duration, we have assumed as a measure the proportion of cases of total permanent disability to 100 fatal accidents with the following results:

NUMBER OF CASES OF PERMANENT TOTAL DISABILITY PER  
100 FATAL ACCIDENTS.

Austria.....	28.5
Germany.....	14.7
Russia.....	12.8
France.....	8.4
Italy.....	7.5

These differences are not to be explained by physical conditions only. We find that the Austrian interpretation of the definition of permanent total disability is the most liberal of all and almost twice as liberal even as that of Germany. Averaging the proportions in the five countries, we obtain 14.38 cases of permanent total disability per 100 fatal accidents, which is about one half of the proportion in Austria alone.

However, in view of the excessive ratio shown in Austria as compared with other countries, the average for the five seems to be preferable, and this indicates 14.4 cases of permanent total disability per 100 fatal accidents. On an assumption of 932 fatalities per 100,000 accidents, we get 133 cases of permanent total disability. As against this figure we have already included 14 cases of loss of both eyes and 3 cases of loss of both

legs in the dismemberment schedule. We have also assumed 62 cases of loss of one eye with injury to the other, 10 per cent. of which, or 6 cases, constitute permanent total disability according to the Austrian experience, so that 23 cases of permanent total disability are already included in the dismemberment schedule, and cases of permanent total disability not dismembers are therefore reduced to 110.

#### PERMANENT DISABILITY OTHER THAN DISMEMBERMENT.

This group of injuries presents perhaps the greatest difficulty in the effort to construct our standard accident table. Permanent reduction in the earning capacity of the injured workman, which does not necessarily destroy his economic usefulness entirely, but puts him down in the economic scale, frequently follows the class of injuries described above as dismemberment. It is evident that a man with one arm is worth less in the labor market than he was while both arms were intact. But permanent partial disability is not at all limited to such self-evident cases. Unhealed fractures, badly reduced dislocations resulting in loose joints, stiff joints, partial paralysis, ruptures, and many similar cases may have the same economic effect as loss of part of body. Because dismembers have been made subjects of special regulation in most acts, it becomes necessary to separate those from other cases of permanent partial disability. Unfortunately, in a good many American acts, and still more in the administration of compensation laws in a good many American states, this condition of permanent partial disability due to other causes than dismemberment is not yet always sufficiently well recognized.\*

Perhaps for this reason it is useless to expect any accurate reports of such cases in the early statistics of compensation in

\*An interesting illustration of this may be found in the report of the Michigan Industrial Accident Board as to accidents occurring between December 1, 1913, and May 31, 1914, as published in the *National Compensation Journal* for June, 1914. The first table of this report is entitled: "Accidents causing permanent partial disability classified by part of body affected," and in this table are listed 318 accidents, every one of which is a case of dismemberment. It seems that the Michigan Industrial Board was absolutely unaware of the existence of these cases of permanent partial disability which are not due to dismemberment, and yet it is quite evident that a large number of such cases must have occurred. They are not self-evident at the time the accident has happened. In a great many of such cases a long time may elapse before the permanent nature will be realized.

this country, but it must not be assumed that because American statistics have not recorded such cases, they do not occur in actual practice. Undoubtedly, they have been handled in each state as cases of temporary disability until the permanent character has been established. Undoubtedly, also, in a good many cases the reduction in earning capacity if not excessive has been and is being disregarded. It is known, however, that there have been such cases in the state of Massachusetts. The first report of the Industrial Accident Board indicates on page 324 that there have been 1,457 cases of permanent partial disability though the number of dismemberments as stated on page 19 is only 967, leaving 490 cases of permanent partial disability not dismemberments, or about 50 per cent. as many as dismemberments. Again, in the first report of the Industrial Accident Board of California covering the period from September 1, 1911, to December 31, 1912, we find an analysis of 9,627 accidents, of which 412 were fatal and 534 resulted in permanent disability, and of the latter only 79 cases or about 15 per cent. are cases of permanent injury not due to dismemberment. In the state of Washington for the first year of operation of the act there have been 685 cases of permanent disability against 279 fatal accidents, the proportion being so high that it was quite probable that a large number of cases not dismemberments have been included.

But while their existence is being recognized, comparatively few of them are as yet recorded. It is necessary, therefore, to turn to European data to get a better conception of their importance and value. As already indicated, a comparison of statistics of various countries is somewhat vitiated by the differences in the definition of an accident, and since the reduction of all the statistical data to one basis of accidents of one day's duration is a rather difficult undertaking, the method of comparing them with the fatal accidents offers a more convenient shortcut.

The following table shows a degree of variation in this proportion among various European countries:

## PERMANENT DISABILITY CASES IN PROPORTION TO FATAL ACCIDENTS.

Countries.	Years.	Number of Fatal Accidents.	Number of Accidents Resulting in Permanent Disability.	Ratio to Fatal Accidents.
Austria.....	1897-1906	8,349	82,446	9.9
Belgium.....	1905-1908	1,838	8,204	4.6
Denmark.....	1899-1906	389	4,192	10.8
France.....	1899-1908	18,708	140,877	7.5
Germany.....	1899-1908	59,893	313,219	5.2
Italy.....	1898-1902	2,224	9,701	4.4
Norway.....	1895-1905	832	4,496	5.4
Russia.....	1904-1906	2,345	34,981	14.9
		84,578	598,116	7.1

The ratio of permanent disability cases to fatal accidents seems to vary from 4.4 in Italy to 14.9 in Russia, the average being 7.1. The ratio seems to be fairly uniform in four or five countries such as Belgium, Italy, Germany, and Norway, being about 5 per cent., but rises to 10 per cent. or over in Austria, Denmark, and Russia. The variations are evidently significant of differences in the matter of judgment and decision in regard to individual cases rather than of bare physical facts. For all of these countries except Austria all cases of permanent partial disability, including those resulting from dismemberment, are stated together. Since the dismemberment cases have already been treated in a different way, it is necessary to obtain information as to the number of other cases, and for this Austria alone offers statistical data. Because of this accidental advantage of Austrian figures over all others, they have been used very largely by the New York State Insurance Department in its work of determining a differential between the cost of compensation under the New York and the Massachusetts compensation acts, and the use of these Austrian figures was very violently contested. The difficulty cannot be denied that Austrian statistics indicate twice as large a number of cases of permanent disability as most other countries. A careful inspection of the Austrian tables as re-published in the twenty-fourth Annual Report of the Commissioner of Labor does raise serious doubts as to whether such liberality of interpretation may be expected in any of the states for the first five or ten years, especially since it is twice as high as in

Germany. Even in Austria the proportion of such cases has been regularly increasing. Thus, in 1897 the proportion of permanent disability cases to fatal accidents was 8 to 1; in 1900, 9.8 to 1; and in 1906, 11.5 to 1.

We feel safe, therefore, in assuming that for the next few years at least, five cases of permanent partial disability against one fatal accident will be nearer the actual conditions than the proportion obtaining in Austria now. In other words, we may safely reduce the number of permanent partial cases as indicated by Austrian figures by 50 per cent.

In our table we have assumed 932 fatal accidents which would make the total number of permanent disability cases 4,660. The number of dismemberments we found to be 2,323 per 100,000. As a matter of fact, Austrian statistics indicate that out of a total of 8,579 cases of dismemberments 795, or 9.3 per cent., were so slight that even in Austria they were not considered as cases of permanent disability. Subtracting this 9.3 per cent. from the 2,323 cases, we have 2,108 cases of dismemberments per 100,000 leading to permanent partial disability. Subtracting this number from the total assumed number of permanent disability cases, we get 2,552 cases of permanent disability not due to dismemberments. Of these, as indicated earlier, 110 are cases of permanent total disability, leaving 2,442 cases of partial permanent disability not due to dismemberment.

#### DEGREE OF PERMANENT PARTIAL DISABILITY.

The next question that requires investigation is the distribution of these cases according to degree of disability, upon which compensation depends. Here again we must draw entirely upon European data, and this again is a matter of judgment largely and everything depends upon the customary method of adjusting such cases. It is reasonable, therefore, to expect a very wide difference between results in different countries.

When an effort is made to compare information on this point as given in the reports of different countries, an additional difficulty arises from the fact that the sub-groupings in different countries are not uniform. Thus, for instance, in

German statistics the permanent disability cases are divided into only four groups: Under 25 per cent. disability, between 25 per cent. and 50 per cent., between 50 per cent. and 75 per cent., and between 75 per cent. and 100 per cent. Italian reports contain ten groups, one for each 10 per cent. of disability, while Austria has a division into seven groups on an entirely different basis. Finally, the third difficulty consists in the fact that in all countries except Austria all cases of permanent disability are lumped together whether due to dismemberment or not. It is reasonable to assume that the degree of disability due to dismemberment is often more serious than that due to other causes. In view of the specific provisions for dismemberships, it is necessary to eliminate these from the cases of permanent disability, but the only country for which this is feasible is Austria.

In the following table is shown the distribution of all cases of permanent disability in Austria according to the degree of disability. Similar data are given also for cases of dismemberment as well as for all cases of permanent disability other than dismemberment.

The first column indicates the rate of benefit in percentage of wages, which is the method of classification used in Austrian sources. The second column states the degree of disability covered by the rate of benefit, the Austrian law granting 60 per cent. of the loss of earning power.

The actual number of cases in 1891 to 1901 is shown in column 3, and the percentage distribution in column 4. A computation of the average degree of disability is made in columns 5 and 6 on an assumption that the mean of the two limits is the average degree of disability for each group. The last column shows the results of this computation. As was to be expected, dismembersments lead to higher degrees of disability. This is well shown by the percentage column as well as by the average computed.

The average degree of disability for dismembersments is 43.1, and for all other cases 29.1. But since there are numerically a great many more cases of permanent disability in Austria not due to dismembersments, the average degree of disability for all cases (32.1) is only slightly affected by the higher degree of disability of the dismemberment cases.

## AUSTRIA.

## ALL CASES OF PERMANENT DISABILITY.

Rate of Benefit (Per Cent. of Wages).	Degree of Disability (Per Cent.).	Number of Cases.	Per Cent.	Average Degree of Disability.	Total Amount of Disability (Average Degree X No. of Cases).	General Average.
5 or under	8 or under	3,629	9.8	4	14,516	
6-11	9-18	11,707	31.7	13	152,191	
12-19	19-32	7,126	19.4	25	178,150	
20-29	33-48	5,760	15.6	40	230,400	
30-39	49-65	3,487	9.4	50	195,272	
40-50	66-83	4,098	11.1	74	303,252	
60	100	1,104	3.0	100	110,400	
		36,911	100.0		1,184,181	32.1

## DISMEMBERMENT.

5 or under	8 or under	603	7.7	4	2,412	
6-11	9-18	1,323	17.0	13	17,199	
12-19	19-32	1,090	14.0	25	27,250	
20-29	33-48	1,789	23.0	40	71,560	
30-39	49-65	1,778	10.0	50	43,568	
40-50	66-83	1,722	22.1	74	127,428	
60	100	479	6.2	100	47,900	
		7,784	100.0		337,317	43.1

## ALL OTHER.

5 or under	8 or under	3,026	10.4	4	12,104	
6-11	9-18	10,384	35.7	13	134,992	
12-19	19-32	6,036	20.7	25	150,900	
20-29	33-48	3,971	13.6	40	158,840	
30-39	49-65	2,709	9.3	50	151,704	
40-50	66-83	2,376	8.2	74	175,824	
60	100	625	2.1	100	62,600	
		29,127	100.0		846,864	29.1

The fact that Austria shows four times as many cases of permanent disability other than dismemberments makes the use of Austrian data subject to criticism. The same liberality which leads in Austria to a recognition of permanent partial disability where such would be denied in other countries may also lead to adjustments in favor of higher degrees of disability than would be the case in other countries. Of course, since we are dealing here not with the number of cases of partial disability but only with their distribution according to degree, these two tendencies mentioned may actually counteract each other, that is, if on one hand the tendency to allow larger degrees of disability than would other countries, would disturb

the percentage series by making the higher groups heavier than they should be, then, on the other hand the tendency to recognize light degrees of permanent partial disability, where in other countries no permanent results would be claimed, would have the opposite tendency of loading the lower groups of the percentage series. In any case, we think it is safer to check up the results of Austrian experience by that of other countries.

The following statements are given with similar computations for Denmark, Italy, and Germany:

DENMARK (1899-1908).

Degree of Disability (Per Cent.).	Number of Cases.	Per Cent.	Average Degree of Disability in Group.	Total Amount of Disability (Average Degree $\times$ No. of Cases).	Average Degree of Disability all Cases (Per Cent.).
5	300	7.2	3	1,500	
6-10	1,400	33.4	8	10,400	
11-20	1,384	33.0	15	20,700	
21-25	265	6.4	23	5,995	
26-50	658	15.6	38	25,004	
51-100	185	4.4	70	12,950	
	4,192	100.0		76,609	18.3

ITALY (1902).

1-4	6	.22	2.5	15	
5-10	1,157	42.10	7.5	8,678	
11-20	576	20.96	15.5	8,928	
21-30	330	12.01	25.5	8,415	
31-40	318	11.57	35.5	11,289	
41-50	130	4.73	45.5	5,915	
51-60	63	2.29	55.5	3,497	
61-70	74	2.69	65.5	4,847	
71-80	62	2.26	75.5	4,681	
100	32	1.16	100.0	3,200	
	2,748	100.00		59,465	21.6

GERMANY (1896-1903).

25 or under	34.88	65.3	15	979.5	
25-50	12.17	22.8	35	798.0	
50-75	4.02	7.5	60	450.0	
75-90	1.18	2.2	85	187.0	
100	1.18	2.2	100	220.0	
	53.43	100.0		2634.5	26.3

The average degree of disability in cases of permanent disability in the different countries appears to be as follows:

	Per Cent.
Denmark, all cases . . . . .	18.3
Italy, all cases . . . . .	21.6
Germany, all cases . . . . .	26.3
Austria, dismemberments . . . . .	43.1
Austria, not dismemberments . . . . .	29.1
Austria, all cases . . . . .	32.1

This difference, like the one in regard to the number of cases of permanent disability, is probably one of judgment rather than of physical facts, and the best method, therefore, appears to be to obtain an average of the data in the various countries so as to get a picture of the average conditions in Europe. Austria was found to be more liberal in determining the number of cases of permanent partial disability, and the same liberality appears in the matter of judgment of the degree of disability, but if Austria seems to be too liberal in these respects, it is probable that the decisions in Denmark, showing nearly 75 per cent. of such cases with less than a 20 per cent. degree of disability, are less liberal than they would be in this country. The tendency of decisions in regard to such cases in this country, where the question comes up at all, would be towards fairly liberal allowances. It is often argued that these results in Germany and in Austria have come only after a long period of experience with compensation, after the training of workmen in malinger, etc. As a matter of fact, the rule works also in an opposite direction. There has been in Germany recently a very strong tendency towards very much stricter decisions as to the degree of disability than in the beginning of the compensation experience. In the absence of any other basis for judgment, we feel that as far as the question of degree of disability is concerned, we are conservative in assuming that adjustments in this country will on the average be as favorable to the injured as they are in Europe.

It was, therefore, decided to average the data for Austria and Italy and Germany. The Danish series was discarded because of the small exposure and its rather unsatisfactory

arrangement. In averaging the other three countries the difficulty was met of groupings not uniformly arranged. To overcome this the following method was used:

For each country a diagram was drawn indicating the percentage distribution within each given interval by an area of a rectangle, having that interval for a base. Then perpendicular lines were drawn at each ten per cent. and the area of each ten per cent. group was computed. While this method is somewhat crude, it does introduce a substantial correction and gives results which appear fairly satisfactory. In the following table the distribution of cases of permanent disability in these three countries is shown, so adjusted as to give the data for groups ending with ten per cent.

DISTRIBUTION OF CASES OF PERMANENT PARTIAL DISABILITY BY DEGREE OF DISABILITY, AUSTRIA, ITALY, AND GERMANY.

Austria.				Italy (Per Cent. of Cases).	Germany (Per Cent. of Cases).
Per Cent. of Disability.	Dismemberment (Per Cent. of Cases).	All Other (Per Cent. of Cases).	All Cases (Per Cent. of Cases).		
0-10	11.1	17.5	16.1	42.3	19.1
11-20	15.6	31.5	28.0	20.9	33.2
21-30	10.0	14.8	13.9	12.0	17.6
31-40	13.5	9.8	10.6	11.6	9.9
41-50	12.7	7.9	8.9	4.7	8.4
51-60	5.9	5.5	5.5	2.3	2.9
61-70	9.1	5.0	5.9	2.7	3.1
71-80	12.3	4.6	6.2	2.3	2.2
81-90	3.6	1.3	1.9	...	1.4
91-100	6.2	2.1	3.0	1.2	2.2
	100.0	100.0	100.0	100.0	100.0

To obtain an average for these three countries only one column was taken for Austria, namely, that giving the distribution for cases other than dismemberments. The averages obtained and the application of these percentages to 2,552 cases are shown in the following table:

Degree of Disability.	Percentage of Cases.	Number of Cases per 100,000.
0-10	26.3	672
11-20	28.6	728
21-30	14.8	378
31-40	10.4	265
41-50	7.0	179
51-60	3.6	92
61-70	3.6	92
71-80	3.0	77
81-90	.9	23
91-100	1.8	46
		—
		2,552

By an independent method we have already determined the cases of permanent total disability to equal 110 (exclusive of dismemberments). As a matter of fact there are very few (and in some countries no) judgments of degree of disability over 80 per cent. because when disability reaches that limit it is practically recognized as total disability on account of the impossibility of obtaining employment. Therefore, to avoid duplications we exclude all the cases of the last two sub-groups and also reduce group 70-80 by 41, leaving in that group only 36 cases so as to balance the figure up to 2,442 cases of permanent partial disability not due to dismemberment.

#### TEMPORARY DISABILITY.

To arrive at the number of these cases it is only necessary to subtract all cases already determined from 100,000 as follows:

Fatal accidents.....	932
Dismemberments.....	2,323
Permanent total disability not dismemberments.....	110
Permanent partial disability not dismemberments.....	2,442
Total serious accidents.....	5,807
Temporary disability only.....	94,193
Total.....	100,000

In connection with this class of injuries the important question is that of duration of disability. In regard to this the largest volume of American experience is contained in the first report of the Massachusetts Industrial Accident Board, where 89,694 accidents are distributed as follows:

Under 2 weeks . . . . .	68,586
2-4 weeks . . . . .	10,568
4-8 weeks . . . . .	6,638
8-13 weeks . . . . .	2,355
13-26 weeks . . . . .	1,275
Over 26 weeks . . . . .	272
 Total . . . . .	 89,694

It would be preferable to use American data such as those quoted above, but unfortunately these figures are deficient for several reasons. First, accident notices, irrespective of duration, have been included which give an abnormally high number of cases under two weeks. Second, the sub-groupings are not sufficiently detailed. In utilizing these figures for the computations of the New York differential, the New York State Insurance Department was forced to assume that the average duration in each group was the mean of the limits, three weeks for the group from two to four weeks, six weeks for the group from four to eight weeks, etc. As the number of cases in each group rapidly declines the average is probably much nearer the lower limit than the mean, and where the margin between the limits is so great a considerable error is introduced thereby. Third, the Massachusetts report seems to divide all the cases into two groups, fatal and those of temporary disability. It is evident that the series quoted above contain all the cases which eventually lead to permanent disability. Even dismemberments are included in that series, the duration meaning that of total disability irrespective of the subsequent partial disability. The result of this is to make a very much higher percentage of accidents of longer duration.

Fortunately a much better series of figures for this purpose is available in the twenty-fourth Annual Report of the United States Commissioner of Labor, namely, the data in regard to

accidents in Russia for a three-year period, 1904 to 1906, where the distribution is given by weekly periods up to thirteen weeks and where the temporary and the permanent cases are separately analyzed. The fact that these figures appertain to Russian conditions need not disqualify them in view of the general theory underlying the standard table.

There is one difficulty about this series: The accidents of under four days' duration are not reported. This makes the total of accidents seven days or under too small. This, however, can be corrected as explained presently. To determine whether the use of these Russian statistics is justifiable, they were subjected to a test to find out how far they are comparable with the Massachusetts figures on general lines. In order to make such a comparison possible, 41 per cent. of notices, relating to accidents of under one day's duration, were taken out of the Massachusetts series. These notices, amounting to 36,774, were deducted both from the total and from the number of accidents of under two weeks' duration, thus obtaining for Massachusetts the following corrected series:

Period of Disability.	Number.	Per Cent.
Less than 2 weeks.....	31,812	60.1
2-4 weeks.....	10,568	20.0
4-8 weeks.....	6,638	12.5
8-13 weeks.....	2,355	4.5
13-26 weeks.....	1,275	2.4
Over 26 weeks .....	272	.5
<hr/>		
Total	52,920	100.0

Distributing 153,843 non-fatal accidents, occurring in Russia, 1904-1906, in the same large groups, we get the following results:

Period of Disability.	Number.	Per Cent.
Under 2 weeks.....	79,577	51.7
2-4 weeks.....	33,776	22.0
4-8 weeks.....	23,164	15.0
8-13 weeks.....	10,144	6.6
Over 13 weeks.....	7,182	4.7
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Total	153,843	100.0

A comparison of these two series indicates a smaller percentage of disability of under two weeks and a larger percentage of accidents in all other groups in Russia as compared with Massachusetts, but this evidently is due to the omission of accidents resulting in disability of under four days' duration in the Russian statistics. This has been corrected in the following manner. The Massachusetts data indicate that there are three times as many cases in the first group, from one day to two weeks, as there are in the second, from two to four weeks. That would make the number of accidents in the under two weeks group in the Russian series 101,328 instead of 79,577, or an increase of 21,751. This correction must also be made in the total, which increases from 153,843 to 175,596. After this correction the similarity of the percentage distribution in both series becomes very much greater, as is shown in the following comparison:

Period of Disability.	Russia Per Cent.	Massachusetts Per Cent.
Under 2 weeks . . . . .	57.6	60.1
2-4 weeks . . . . .	19.3	20.0
4-8 weeks . . . . .	13.2	12.5
8-13 weeks . . . . .	5.8	4.5
Over 13 weeks . . . . .	4.1	2.9
	100.0	100.0

A slight difference between the two series still remains indicating longer periods of duration in Russian statistics. This may be easily explained by the fact that some of the Massachusetts information is premature because in a good many cases the period of disability was unterminated at the time the statistical data were collected. In further support of these figures we may quote an experience of over 20,000 accidents to United States Government employees, 1908-1911, indicating the following distribution:

Period of Disability.	Per Cent.
Under 2 weeks . . . . .	55.1
2-4 weeks . . . . .	20.2
4-8 weeks . . . . .	14.0
8-13 weeks . . . . .	4.5
Over 13 weeks . . . . .	5.1

While these comparisons prove that the Russian statistical data are quite applicable to American experience and therefore may be used here, further refinement becomes necessary. The figures as quoted include both temporary and permanent cases, but the treatment of permanent cases, especially dismemberment, in many state laws differs. In several states, for instance, it is specifically provided that the so-called specific dismemberment benefits should be exclusive of all other benefits. In other states, on the contrary, both temporary total disability benefit and dismemberment benefit may be made in the same cases. It becomes necessary, therefore, to separate these two groups of accidents and to construct a separate series of distribution by duration for the temporary injuries and also for the temporary disability period of permanent injuries. It is quite evident that in serious dismemberments or other accidents leading to permanent disability of a partial character, the initial stage of total disability will on an average be very much longer than in cases which leave no permanent results. As already stated such a separation is possible by means of Russian statistics, which is an additional argument for their use here.

DURATION OF DISABILITY IN TEMPORARY DISABILITY CASES ONLY. RUSSIA (1904-1906).

Duration.	Number of Cases in Russia.	Per Cent.	Computed Number of Cases for the Standard Table.
1-7 days	59,925*	39.5	37,113
8-14 "	38,667	25.5	23,925
15-21 "	19,551	13.2	12,433
22-28 "	11,272	7.4	6,970
29-35 "	7,167	4.7	4,427
36-42 "	4,335	2.9	2,732
43-49 "	2,812	1.8	1,695
50-56 "	1,897	1.2	1,130
57-63 "	1,483	1.0	942
64-70 "	944	.6	565
71-77 "	715	.5	471
78-84 "	571	.4	377
85-91 "	459	.3	283
92-182 "	1,492	1.0	933
Over 182 days	345	.2	197
Total.....	151,635*	100.0	94,193

\*21,751 accidents were added to the group "1-7 days" and to the total, so as to adjust it to our standard basis. In the last column the numbers have been re-computed on a basis of a total of 94,193, as assumed in the standard series.

The Russian classification does not go beyond 13 weeks, throwing all the cases over that period into one group. The number of such cases was 1,897, or in the standard series 1,130. It was more convenient to distribute these 1,130 cases in the two groups, 13-26 weeks and over 26, in proportion to the similar distribution in Massachusetts (in percentages of 81.2 and 18.8). The groups above are so narrow that the average duration of an injury in each group can easily be assumed as the mean between the limits because those are confined within one week. This, however, does not apply to the last two groups. The Russian sources indicate not only the number of cases in the group, but also the total number of the days of disability. The average duration of disability in the last group over thirteen weeks was 137 days or 19.5 weeks, which is just the mean between 13 and 26, so that for all practical purposes this figure may be accepted for the last two groups.

#### THE STANDARD TABLE.

The above analysis completes the distribution of 100,000 accidents according to their results as far as disability is concerned. The table may be given here as a whole:

## STANDARD DISTRIBUTION OF ACCIDENTS TABLE.

Fatal cases.....	932
Dismemberments.....	2,323
1. Loss of left arm.....	64
2. Loss of right arm.....	95
3. Loss of left hand.....	50
4. Loss of right hand.....	61
5. Loss of left thumb.....	29
6. Loss of right thumb.....	30
7. Loss of left index.....	59
8. Loss of right index.....	69
9. Loss of left middle finger.....	26
10. Loss of right middle finger.....	31
11. Loss of left ring finger.....	14
12. Loss of right ring finger.....	17
13. Loss of left little finger.....	32
14. Loss of right little finger.....	34
15. Loss of thumb and one or more fingers, left hand.....	14
16. Loss of thumb and one or more fingers, right hand.....	17
17. Loss of two or more fingers, left hand.....	63
18. Loss of two or more fingers, right hand.....	66
19. Loss of one phalange of left thumb.....	55
20. Loss of one phalange of right thumb.....	62
21. Loss of phalange of left index.....	83
22. Loss of phalange of left middle finger.....	52
23. Loss of phalange of right index.....	93
24. Loss of phalange of right middle finger.....	53
25. Loss of phalange of ring finger, left hand.....	25
26. Loss of phalange of ring finger, right hand.....	19
27. Loss of phalange of left little finger.....	18
28. Loss of phalange of right little finger.....	17
29. Loss of fingers accompanied by injuries of other fingers, left hand.....	172
30. Loss of fingers accompanied by injuries of other fingers, right hand.....	173
31. Loss of one leg.....	129
32. Loss of both legs.....	3
33. Loss of toes.....	57
34. Loss of one eye.....	465
35. Loss of one eye with injury to the other.....	62
36. Loss of both eyes.....	14
Permanent total disability other than dismemberments.....	110
Permanent partial disability other than dismemberments.....	2,442
Leading to Disability of	
1-10 Per Cent.....	672
11-20 ".....	728
21-30 ".....	378
31-40 ".....	265
41-50 ".....	179
51-60 ".....	92
61-70 ".....	92
71-80 ".....	36
Temporary disability.....	94,193
Not over 1 week.....	37,113
1- 2 weeks.....	23,925
2- 3 ".....	12,433
3- 4 ".....	6,070
4- 5 ".....	4,427
5- 6 ".....	2,732
6- 7 ".....	1,695
7- 8 ".....	1,130
8- 9 ".....	942
9-10 ".....	565
10-11 ".....	471
11-12 ".....	377
12-13 ".....	283
13-26 ".....	933
Over 26 weeks.....	197
Total.....	100,000

The claims made for this table must not be misunderstood. It cannot be assumed for a moment that any 100,000 accidents occurring in this country will comply absolutely in their distribution with the proportions indicated in the table. Undoubtedly, accidental variations may occur, and, furthermore, a certain essential difference between conditions in this country and those assumed in the construction of the table may eventually develop when actual experience has been compiled. The claim is made, however, that the cost of any 100,000 cases will not vary greatly from the cost of the accidents distributed in the Standard Table, and another claim may be made for the table still more emphatically, that even if the actual cost of 100,000 accidents may differ, the table is sufficiently accurate for the purpose for which it was constructed, namely, to enable us to measure the differences between compensation acts, because it is, after all, not the absolute cost but only the comparison of costs that we are trying to arrive at. In that respect some similarity may be indicated between this standard accident table and mortality tables. Not even the largest life insurance company would expect the actual deaths to comply absolutely with the mortality table even if the latter were ideally correct. When computed by independent age groups, the profits and losses in the various groups will probably fluctuate from year to year, but all of these fluctuations do not interfere with the reliability of the mortality table as a whole. The vast amount of experience in compensation insurance which will undoubtedly accumulate in this country within a very few years, will enable us to reconstruct this table, but the method of its application will not be changed thereby.

#### TEMPORARY TOTAL DISABILITY IN PERMANENT CASES.

While the entire distribution of 100,000 accidents has been accomplished, there are several additional factors which must be taken into consideration and must be studied statistically. The first is the determination of the periods of total disability which accompany cases of dismemberment and of permanent partial disability not dismemberment. For reasons indicated above, this must be computed separately because this addi-

tional liability is not recognized in all compensation acts. The standard distribution according to duration as given above will not apply because the average nature of these injuries is very much more severe and the period of recovery longer. The Russian figures are the only ones which furnish information on this point. In the following table the 2,442 cases of permanent partial disability and the 2,323 cases of dismemberments are distributed according to the duration of total temporary disability applying to both groups the same percentage distribution ascertained from Russian statistics. The two groups of accidents are distributed here separately, because in some states dismemberments are excluded and then only the column for permanent partial disability must be used, while in others the total column may be applied.

Period of Disability.	Per Cent.	Number of cases.		
		Permanent Partial Disability.	Dismember- ment.	Total.
Under 1 week.....	5.7	139	132	271
1-2.....	5.6	137	130	267
2-3.....	5.9	144	137	281
3-4.....	6.5	159	152	311
4-5.....	7.8	190	181	371
5-6.....	7.5	183	174	357
6-7.....	7.0	171	163	334
7-8.....	6.6	161	153	314
8-9.....	6.9	168	160	328
9-10.....	5.2	127	121	248
10-11.....	4.7	115	109	224
11-12.....	4.3	105	100	205
12-13.....	4.0	98	93	191
13 and over.....	22.3	545	518	1,063
	100.0	2,442	2,323	4,765

#### DEPENDENCY IN FATAL ACCIDENT CASES.

The number of fatal accidents per hundred thousand was determined in the standard series as 932, but the correct valuation of their cost requires a good deal of additional statistical information. In regard to the number and status of the dependents, the laws differ very much. In some cases specific groups of dependents are provided for by definite proportions, and in such cases it becomes necessary to determine the number of such dependents who may be expected to survive. In

other states all dependents are given the same rights except as to the distinction between total and partial dependents, although in most cases certain relatives are designated as total dependents. As in all cases widows and orphans, under a certain age, are recognized as total dependents, the first important fact that must be ascertained is the conjugal distribution of victims of fatal accidents. In regard to this question a very useful table is found in the report of the Washington Industrial Accident Commission for 1912, where the conjugal condition of all injured employees is given, indicating 3,351 single and 3,005 married. No data are given for widows or divorced persons, and a letter of inquiry to the Commission brought the reply that widowed persons without children were classified with the single and widowed with children with the married persons. The proportion, however, of single men in the state of Washington appears unusually high, nearly 53 per cent., and it may be explained by the character of population and industry in a frontier state, but it will be utterly inapplicable to older settled communities.

In France for the period 1898-1905 insurance companies reported 9,055 fatal accidents\* distributed according to conjugal condition as follows:

	Number.	Per Cent.
Single.....	3,057	33.8
Married.....	5,266	58.1
Widowed.....	578	6.4
Unknown.....	154	1.7
<hr/>		
Total.....	9,055	100.0

French experience indicates, therefore, that little over one third of the persons fatally injured are single. In Germany† there were 68 widows for each 100 fatal accidents reported to the Industrial Accident Associations, which is a somewhat higher ratio than in France, and may be easily explained by the comparatively higher marriage rate of Germany.

It seems safer for this country to assume the general proportion of married and unmarried people among the male working

\* Twenty-fourth Annual Report, United States Bureau of Labor, p. 704.

† *Ibid.*, p. 1154.

population. The figures are taken only for the male population because the percentage of married persons is much higher for the female population, while the number of fatal accidents to women is extremely small and therefore can be disregarded.

Taking the entire male population of the country over 20 years of age, their distribution by conjugal condition is as follows:

Single .....	29.1 Per Cent.
Married.....	64.6 Per Cent.
Widowed.....	5.3 Per Cent.
Divorced.....	.6 Per Cent.
Unknown.....	.4 Per Cent.
<hr/>	
Total.....	100.0 Per Cent.

The practical agreement of these United States Census figures with the results of special investigation of fatal accidents in France and Germany allows us to assume this as a basis for our standard table. For purposes of simplicity the unknown are thrown in with the single persons, and the divorced with the widows, so that the assumption is as follows:

Single persons.....	29.5 Per Cent.
Married persons.....	64.6 Per Cent.
Widowed persons.....	5.9 Per Cent.

which on the basis of 932 fatal accidents gives the following results:

Single persons.....	275
Married persons.....	602
Widowed persons.....	55
<hr/>	
Total, fatal accidents.....	932

In a large number of states, as for instance Massachusetts, Kansas, Rhode Island, Nebraska, and others, the only point at issue in granting benefits for fatal accidents is that of existence of dependents, either total or partial, without any specific benefits being prescribed for specific classes of dependents. In such cases the assumption is justified that in all cases where victims of accidents were married there are total dependents, and as far as the widowers are concerned, while there may be

a few cases where no orphans survive, yet they would be the exception, and in absence of definite information it was assumed that for the widowed as well as married total dependents existed in every case, which gives 657 cases with total dependency. In addition to that there must be a certain number of the single fatally injured who leave dependents, either total or partial.

For the distribution of the total accidents to single persons in regard to existence of dependency, some French data have been used. They indicate that out of 3,057 single persons fatally injured in France, 2,179, or 71.39 per cent., left no dependents under the French act. The statistics of dependency in the state of Washington have already been referred to. It was pointed out that the proportion between single and married persons in the state of Washington would be exceptional from that characteristic of other states. The data in regard to the number of dependents for each one of the two groups need not be disqualified from use. As reference to that table will show, out of 3,351 single employees injured, 2,457, or 73.3 per cent., have no dependents at all.

The higher percentage in the state of Washington may easily be explained by the larger proportion of young men without any relatives in the state, due to the transitory condition of the population, but the difference between the Washington and the French proportion is so slight that evidently we are dealing here with a fairly uniform relationship. We have, therefore, assumed that some 71 per cent. of the single persons fatally injured leave no dependents at all, or 195 cases out of the 275 fatal accidents to unmarried employees, or 932 fatal accidents.

The final question requiring an answer is that of distribution of the remaining 80 cases according to the number leaving total dependents and that leaving partial dependents only. It proved impossible to obtain any statistics on this point. The Washington figures used here do not show it. The Massachusetts report for the year 1912-13 shows the existence of 103 partial dependents for the 470 fatal accidents, but it does not indicate the number of cases to which these 103 partial dependents belong, nor in how many cases these partial dependents

were the only dependents. The Washington figures indicate that in the case of single persons fatally injured who leave any dependents at all, the average number of dependents is nearly 2, which would indicate that there were in the state of Massachusetts about 50 cases of partial dependency. However, there is no evidence that the partial dependents recorded were the only dependents in the respective cases. In recognizing the economic motive which would influence people to claim total dependency in all possible cases and the difficulty which must frequently arise in disproving such claims, we have assumed somewhat arbitrarily that in about 60 per cent. of the cases of fatal injuries to single employees leaving any dependents at all, the dependency would be recognized as total, and in 40 per cent. only partial dependence would exist, which makes the total number of cases with total dependents 48, and the number of cases with partial dependents 32. The final result of this analysis, therefore, is an assumption that the 932 cases will be divided according to dependency as follows:

Total dependents.....	705
Married.....	602
Widowed.....	55
Single.....	48
Partial dependents.....	32
No dependents.....	195
	—
Total.....	932

#### NUMBER OF DEPENDENTS.

In a few of the states having compensation acts at present the provisions for fatal accidents are somewhat more complicated. Specific benefits may be granted either according to the number of dependents surviving, or with an even greater effort at economic justice, according to the class or rather degree of relationship and number of dependents surviving. This is particularly true of the states of New Jersey, Minnesota, and New York, and similar provisions may be expected to become more numerous in the future. Therefore, it became necessary to obtain some data concerning the number of dependents surviving. Moreover, it is not always sufficient

to know the total number of dependents surviving for the entire number of fatal accidents, but rather the distribution of cases according to the number surviving in each particular case. Unfortunately, our Census statistics on the size of families are not in such condition as to make the data available for our purposes. The best information that is as yet available has been collected by the Washington Industrial Accident Commission in its report for 1912, giving the distribution of all persons injured whether fatally or not according to class and number of dependents.

DEPENDENTS OF EMPLOYEES INJURED IN THE STATE OF WASHINGTON, 1912.

SINGLE PERSONS.	Number of Cases.	Number of Dependents.	
1. Single and no dependents.....	2,457	—	
2. " " 1 "	440	440	
3. " " 2 "	338	676	
4. " " 3 "	49	147	
5. " " 4 "	32	128	
6. " " 5 "	13	65	
7. " " more than 5 dependents.....	22	132	
	3,351	1,588	
MARRIED PERSONS.	Number of Cases.	Number of Dependents.	Number of Children.
1. Married and no children.....	800	800	—
2. " " 1 "	628	1,256	628
3. " " 2 "	556	1,668	1,112
4. " " 3 "	356	1,424	1,068
5. " " 4 "	196	980	784
6. " " 5 "	111	666	555
7. " " 6 "	43	301	258
8. " " 7 "	14	112	98
9. " " 8 "	3	27	24
10. " " 9 "	1	10	9
11. " no children, 1 other dependent.....	83	166	—
12. " " 2 " dependents.....	19	57	—
13. " " 3 "	9	36	—
14. " " 4 "	1	5	—
15. " " more than 4 dependents.....	1	6	—
16. " 1 child, 1 other dependent.....	53	159	53
17. " 2 children, 1 other dependent.....	35	140	70
18. " 3 " 1 "	26	130	78
19. " 4 " 1 " "	16	96	64
20. " 5 " 1 "	4	28	20
21. " more than 5 children, 1 dependent.....	5	40	30
22. " 1 child, 2 dependents.....	13	52	13
23. " 2 children, 2 dependents.....	12	60	24
24. " 3 " 2 "	2	12	6
25. " 4 " 2 "	3	21	12
26. " 5 " 2 "	5	40	25
27. " more than 5 children, 2 dependents.....	1	8	6
28. " 1 child, 3 dependents.....	5	25	5
29. " 1 " 4 "	3	18	3
30. " 2 children, 4 dependents.....	1	7	2
	3,005	8,350	4,947

This table shows that in the 3,005 cases of married persons injured, there were altogether 8,350 dependents. Presumably there were 3,005 consorts and of the remaining 5,345 dependents, 4,947 were children and 398 other dependents, largely parents. The Washington law recognizes dependency of children up to the age of 16 only; presumably only children of that age were included in the table, showing 164.6 children under 16 per 100 parents.

This data must be subjected to some sort of a check to ascertain how far the Washington data are at all applicable to conditions throughout the country. The United Census States for 1910 indicates that there were in that year 31,320,334 children under 16, and that the number of males married, widowed, and divorced was 19,720,152, giving a proportion of 177 children under 16 per hundred married males. The excess of this average over that in the state of Washington may be easily explained by the fact that a certain number of children under 16 have no father living. The proportion, therefore, of 164.6 children per 100 fathers may be accepted as essentially correct. Where the law grants rights to children up to the age of 18, the number of surviving children will naturally be larger. Based upon the figures of the United States Census, the estimate is made that the number of children under 18 per 100 parents should be increased to 184.4.

Utilizing these averages for the definite number of fatal injuries assumed in our standard table, we have as follows:

	Number of Cases.	Number of Dependents.
Widows, in accidents to married employees .....	602	602
Orphans, in accidents to married or widowed employees.....	657	1,071
Other dependents, in accidents to married employees.....	657	87
Other dependents, in accidents to single employees.....	80	144
All cases, with dependents .....	737*	1,904

This indicates 258 dependents per 100 fatal accidents leaving dependents, or 205 per 100 fatal accidents. If, however, dependent children up to the age of 18 instead of 16 be taken into consideration, the number of dependent children will

\* This total does not represent the addition of cases in the column because in the latter the cases were entered more than once.

increase to 1,210, and the total number of dependents to 2,044, or 277 per 100 fatal accidents leaving dependents, or 219 per 100 fatal accidents occurring, which shows a remarkably close approximation to the German figures of dependents surviving, though computed independently on a basis of Washington figures and certain United States Census data.

In a careful valuation of fatal accidents further information may be necessary in regard to the relationship of dependents other than widowed and children. While information on this subject is very limited, nevertheless some use may be made of the Washington figures. We find that in 3,005 cases of injuries, there were 8,350 dependents of whom presumably 3,005 were widows and 4,947 were children, leaving for other dependents 398. The number of cases in which such other dependents were ascertained is 297. Of these, 222 cases had only one dependent other than widow or children, 55 cases had two dependents other than wife or children, and only 20 cases had more than two dependents of this class, the total number of such dependents in the 20 cases being 71. The number of dependents, therefore, in excess of two was only 31. The assumption seems justified that where only one dependent other than wife or children exists, that may be assumed to be either aged father or mother, and other dependents, largely brothers or sisters, were very few, only 31 cases out of 3,005, or about 1 case in a hundred fatal accidents. That proportion appears to be strikingly low, but it must be remembered that in most cases where specific benefits are given, the share assigned to the widow, orphans, or parent, will be sufficiently large to absorb the entire maximum amount of compensation allowable, so that in only a very few cases would brothers and sisters actually be in a position to claim compensation independently.

As far as the dependents of single persons are concerned, we have the Washington data indicating about 180 dependents per 100 cases leaving dependents. We have the indication from the French statistics that the proportion is only 133 per 100 cases, but the French act does not cover other dependents except parents. We may assume, therefore, that of the 180 dependents per 100 cases, 133 represent parents, and 47 other

dependents, largely brothers and sisters. Applying this proportion to the 180 cases of single employees in which dependents are expected according to our assumption, we may assume 106 parents and 38 brothers and sisters as dependents of single persons fatally injured. On the basis of such assumptions the cost of the 932 fatal accidents may be fairly accurately computed.

#### AGE OF INJURED AND DEPENDENTS.

In most states compensation to dependents is given for a temporary period only. In such states it may be assumed that in the majority of cases, and especially when the period is short, the full amount will be paid even if one of the dependents happens to die during the period of compensation, because other dependents would probably arise to claim the benefit. Even there exceptions must be made in a case of widows surviving without other dependents, because in such cases the death of the widow may cause the payments of benefits to be discontinued altogether. Actuarially, we are dealing here with the cost of a temporary annuity where the element of mortality plays an important part. Still more important is the element of mortality in a case of benefits to children, or all cases where life benefits are granted by the compensation act. Many acts grant life benefits in permanent total disability cases, and at least one is certain to grant life pensions in all grave injuries (California), while in several other states (New York, Ohio, Kentucky, and Maryland) there is a possibility that life pensions may be granted under the law in all permanent partial injury cases. It is evident, therefore, that the question of age both of the injured persons and the dependents acquires an important value in computing cost of compensation. Various statistical sources must be utilized to obtain some information on this subject. The Massachusetts Industrial Accident Board's Report for 1912-13 states the ages of fatally injured persons, from which the following computation has been made:

## AGES OF FATALLY INJURED.

	Number.	Average Age.	Aggregate Ages.
Under 16 years.....	4	15	60
16-21.....	18	18.5	333
21-30.....	135	25	3,375
30-40.....	113	35	3,955
40-50.....	83	45	3,735
50-60.....	66	55	3,630
Over 60.....	55	65	3,575
	474		18,663

The average age at death in fatal accidents appears to be about  $39\frac{1}{2}$  years in the state of Massachusetts. On the other hand, in Illinois, according to the 6th Report of the Bureau of Labor Statistics entitled Industrial Accidents in Illinois for 1912, the ages of the fatally injured are given as follows, indicating an average age of 35:

## AGES OF FATALLY INJURED.

	Number.	Average age.	Aggregate ages.
Under 20 years.....	5	16	80
20-25.....	30	22.5	675
25-30.....	30	27.5	825
30-35.....	30	32.5	975
35-40.....	23	37.5	863
40-45.....	20	42.5	850
45-50.....	13	47.5	617
50-55.....	10	52.5	525
55-60.....	8	57.5	460
60 and over.....	4	65	260
	173		6,130

In the absence of more accurate information it seems advisable to assume one average age for all states for fatal injuries, which is approximately 37. In handling permanent partial disability cases, use was made of the information given by the Austrian statistics, which indicates that the average age increases with the degree of disability; or perhaps it would be more accurate to state that the degree of disability is affected by the average age, so that while for temporary cases and for cases of very light degree of permanent disability, the average age appeared to be 37, it rose to 39 where the degree of disability is over 50 per cent., and to 42 where the degree of disability was total, and computations were based upon these broad conclusions.

A very important question is the age of the widow rather than of the person fatally injured. Unfortunately, in this country there seems to be scarcely any information about the respective ages of consorts. The average age of the widows as given by the United States Census would evidently be of no advantage, because what must be ascertained here is the average age at which widowhood arises, while the Census deals with widows whose widowhood has arisen at different periods. An effort was made to utilize the statistics of the United States Census for this purpose, and the method is indicated here though perhaps the results should be utilized, if at all, with a great deal of caution.

In the following table taken from the Thirteenth Census for 1910 is shown the distribution of married males and married females according to age group. An average age for married males and females has been computed on the assumption that the average age for each group is equal to the mean of the limits of that group.

Age Groups.	Married Males (000's omitted).			Married Females (000's omitted).		
	Number.	Average Age.	Aggregate.	Number.	Average Age.	Aggregate.
15 to 19 yrs....	52	17.5	910	513	16.5	8,978
20 " 24 " ....	1,100	22.5	24,750	2,225	22.5	50,063
25 " 29 " ....	2,353	27.5	64,708	2,823	27.5	77,633
30 " 34 " ....	2,611	32.5	84,858	2,620	32.5	85,150
35 " 44 " ....	4,873	39.0	190,047	4,410	39.0	171,990
45 " 54 " ....	3,659	49.0	179,291	2,904	49.0	142,296
55 " 64 " ....	2,113	59.0	124,667	1,480	59.0	87,320
65 and over.....	1,304	69.0	89,976	687	69.0	47,403
	18,065		759,207	17,662		670,833

The average age of married men appears to be 42, and the average age of married women 35. It cannot be assumed that these respective ages apply to the persons fatally injured and their widows, but it does seem to indicate that there is a certain relationship between the average ages of married men and married women. The possible errors are the inclusion of married males or females whose wives (respectively husbands) are not included in this table. That would hold true of married men whose wives are abroad (particularly immigrants) whose number must be perceptible. On the other hand, the

number of married women immigrants in this country whose husbands are abroad is probably not very large. The only reason for discarding this computation is the rather startling character of the results indicating a difference of seven years between the age of a married man and woman, which is larger than would naturally be expected. Of course, the tendency to under-estimate age on the part of the married female must be taken into consideration.

#### AGES OF SURVIVING CHILDREN.

Where benefits are granted to surviving children up to a certain age, whether 16 or 18, their ages are a matter of importance. There is no reason to assume that the distribution according to age of the children surviving persons fatally injured would on the whole be any different from a general distribution by age of children under 18 or 16 years in this country. For this purpose the statistics of the United States Census may be utilized. When this was done, it appeared that the distribution among different ages beginning with under 1 year and up to 17 years was fairly uniform. There was a slight excess of children of lower ages but this was comparatively small. Thus, for instance, the number of children under 6 years of age constituted 36.3 per cent. instead of 33.3 percent. It is therefore safe to assume the mean to represent the average age fairly accurately. In other words, if the law provides compensation up to the age of 16, it is fair to assume 8 as the average age, and if the law extends the compensation up to 18 years of age, the assumption should be of an average age of 9. That slightly over-estimates age. On a more careful computation, it would probably prove to be lower than that. On the other hand, because of the factor of compound interest, the value of a temporary annuity lasting until the age of 18 as computed at the age of 9, would probably be larger than the average value of annuities up to 18 years of age computed for children of ages from 1 to 17, so that those two factors counteract each other, and for the purpose of simplicity the mean may be accepted.

In certain states this formula will not apply without modifications. Thus, for instance, the New Jersey act makes the

amount of compensation in fatal accidents dependent upon the number of dependents only, but irrespective of the degree of relationship—so much is given to one dependent and a somewhat higher amount in case of two dependents, and so on. The computation of the cost of fatal accidents would present serious difficulties except for the data available from the Washington table. Always remembering that a distribution in New Jersey between single and married persons would be different from that in Washington, it may nevertheless be assumed that both of these groups independently indicate the number of cases leaving from one to five or six dependents, and the following table may therefore be used, in which the cases in New Jersey are arranged in proportion to the cases in Washington:

	Married Wash.	Per Cent.	Married N. J.	Single Wash.	Per Cent.	Single N. J.	Total N. J.
1 dependent.....	800	26.6	175	440	49.2	39	214
2 dependents.....	711	23.7	156	338	37.8	30	186
3 " "	628	20.9	137	49	5.5	5	142
4 " "	413	13.7	90	32	3.6	3	93
5 " "	240	8.0	52	13	1.5	1	53
6 " "	213	7.1	47	22	2.4	2	49
Totals.....	3,005	100.0	657	894	100.0	80	737

#### METHODS OF APPLICATION OF THE STANDARD TABLE.

It seems proper to conclude this study of the Standard Accident Table with a brief outline of the methods by means of which the table may be used for determining the comparative costs of compensation acts. In general, the method consists in a careful valuation of the 100,000 accidents according to the provisions of each compensation act. The table is sufficiently detailed to permit such a valuation, and in most cases, it is believed that no additional information is necessary though such a need may arise occasionally. Any experienced actuary will be enabled to make such computations with the aid of the table at hand.

The comparison of the costs of different acts is much simplified by assuming a week's wages as a unit rather than dollars and cents, because almost all benefits in compensation acts are

expressed in terms of weekly wages, and on the other hand, the premiums are computed in percentages of the pay roll, so that in this way any differences between state and state which might arise from differences in wages would be eliminated in the computation. It is evident that in comparing the cost for two states, the differences in wages may be disregarded because they will be automatically corrected in the premium rate.

The computation of the cost of cases of temporary total disability appears very simple by the aid of the series showing their distribution by duration. This series being detailed with intervals of one week only, it is quite safe to assume that the average duration of a case in each group is equal to the mean of the limits of that group. Then the waiting period may be deducted from the average duration for each group, and for the compensated period the proper percentage of wages, whether it be 50 per cent., 60 per cent., or any other percentage, may be computed. One can readily see how easy it is to compute the cost of any changes in waiting period or in the treatment of these cases by applying the table as indicated.

The cases included above do not represent the entire expense for temporary total disability. In every case eventually leading to permanent partial disability, including cases of dismemberment, there is a preceding period of total disability which often is compensated for independently of the benefits for the permanent partial disability arising subsequently. The method of valuation which may be used for this part of the cost of the cases is identical with that used for the preceding group. The same conditions of waiting period apply here. The most important fluctuation between states refers to the question of dismemberment, since in some states it is definitely provided that the so-called specific dismemberment benefits are exclusive of any other payments. In such states, therefore, this additional cost of temporary total disability in dismemberment cases may be disregarded.

The cost of dismemberment cases can be computed very easily by means of the table giving the distribution of the dismemberment cases, since almost all the compensation acts contain a definite schedule giving the amount of benefits payable for each kind of dismemberment. Since payments for

some of the graver cases of dismemberment are for fairly long periods, the question of commutation of future payments arises. It is true that in the past it was not customary to take into consideration the difference between present and future values in computing the experience in the casualty business. It seems necessary, however, in actuarial work in connection with compensation problems to introduce this factor of the commutation. Under old liability conditions, neither the amount of payments to be made nor the time when they were to be made could be foretold in advance with any degree of accuracy. Therefore, the addition of all payments made no matter when was assumed to represent the true cost. Whatever profit was made as a result of deferring payments went into the investment account, and for this reason insurance companies were often able to earn a profit although showing a loss in their underwriting accounts. Compensation legislation makes the period of payments quite definite, and wherever it may seem advantageous to settle in lump sums in advance of the time when payments are due, most of the laws require the commutation of such payments to be made according to definite rules. It is therefore necessary to take account of such differences between present and future values. It is quite evident that the increase of the benefit periods from five years to ten years, for instance, would not necessarily be equivalent to a doubling of the cost, not only because of the lower value of deferred payments, but also because of the possible effect of mortality, as in most compensation acts benefits cease on death of the injured person or the beneficiary from causes other than due to the accidental injury. Moreover, in cases where life pensions are granted, as for instance to widows in some states and to cases of total permanent disability in a great many other states, it is quite impossible to compute the cost at all unless the actuarial factor of present value of annuities is taken into account.

In computing the cost of permanent partial cases other than dismemberments, the distribution of such cases by degree of disability is useful because the amount of benefits would be expressed in a percentage of the weekly wages proportionate to the degree of disability. A short-cut method seems to be

indicated by computing the average degree of disability for all cases of this group. The cost of these cases will then be governed by the scale of compensation contained in the act, by the number of these cases, and by the number of weeks for which benefits under this provision must continue. As a matter of fact, it is probable that in only a small percentage of cases under our experience will permanent partial disability be compensated by very small weekly benefits. Much more likely is the commutation of such cases, except the very severe ones. But that should not influence the cost of the commutations done under supervision of Accident Boards or Commissions, as the present value is presumably computed in accordance with the provisions of the law.

As far as the few but expensive cases of permanent total disability are concerned, the method of computing the cost may be the same as that for permanent partial disability except that cases being those of total disability, there is no question as to the degree of disability, and the full value of the compensation scale is payable in such cases. Wherever the payments are limited in the law to a certain number of weeks, a temporary annuity for that period may be computed while in the few other states providing life pensions, life annuity has to be figured on. Almost without exception these benefits cease on death not due to the accident, which of course would be taken into consideration in figuring either temporary or life annuities.

In regard to fatal accidents, there may perhaps be more variations between different states than for any other group. In some states the computation is simple enough because benefits are given for a limited number of weeks and because beneficiaries are not specified and the same benefits are given no matter how many total dependents survive. Under such conditions and especially when the duration of payments is for a short term of years only, the mortality factor of dependents may be discarded on the assumption that if one dependent should die others would survive and appear to claim the remaining benefits. In a few states special computations become necessary as to the number and kind of dependents surviving, but it is believed that the material furnished in this

study will be sufficient to meet most of the exceptional conditions arising out of different acts. Perhaps the greatest difficulty may arise in connection with the valuation of the factor of re-marriage, as is well remembered by all who were observing the preparation of the New York compensation rates. The thorough discussion of the problem of re-marriage at the time indicated the actuarial difficulties arising out of this problem, but since the New York Workmen's Compensation Commission has issued actuarial data for computing the pensions to widows subject to death and re-marriage, these may be utilized in a comparative study. It seems scarcely necessary to point out that such use of the tables for purposes of comparison may be justified, even if for purposes of valuing individual cases and for buying or selling such annuities, the accuracy of the tables may be disputed by some, as has been done.

Burial benefits are granted in some states only in case no dependents survive and in a few states in all cases of fatal accidents. The standard table provides an easy method for accounting for this difference in state laws. Since, however, burial benefits are stated in the act in dollars and the entire computation may be made here with the weekly wages as a unit, it may be necessary to convert the cost of burial benefits into weekly wages by assuming or ascertaining the average weekly wage for injured persons in the state.

When the cost of compensation of the hundred thousand accidents has been computed in terms of weekly wages, an interesting problem arises in connection with the effect of the minimum and maximum provisions. All compensation laws contain some such provisions which are often referred to as "limits." By this is meant the provision of the act limiting the maximum weekly benefit that may be granted irrespective of the wages and also establishing a minimum, in case the regular scale granted by the law would produce an amount insufficient even for the direst needs of the injured or his family. Like all other provisions these limits vary greatly. Perhaps the most frequent type is that of \$5 to \$10, though the minimum falls in one or two states to \$4 and it rises in some of the western states to \$6. The maximum provisions are often increased to \$12 and in some states to \$15 a week. There has

been a good deal of discussion as to the results of these limits upon the cost of compensation. Commissions have often argued that the maximum limit materially reduces the benefits provided and therefore the cost, while on the other hand, insurance men have frequently claimed that minimum provisions are an additional burden of great magnitude.

As far as the writer knows no specific method of measuring the results of such limits has ever before been suggested. Since these limits cannot be disregarded in comparing the cost of two acts, a method of fairly exact measurement is presented here which is convenient because of its simplicity, provided sufficient data are available. These consist of some statistics as to distribution of injured persons according to wage group. Data as to the average wages, so common in American statistical literature, would be of no advantage in this connection. Given the distribution of injured persons by wage groups, the method is to compute the average benefits which would be granted to the total number of injured persons included in the table (or to 100 injured employees if the table has been converted to a percentage basis) if there had been no limits. Then a similar computation is made to obtain the average benefits granted with proper regard for limits, by increasing the benefit up to the minimum limit for the lower wage groups and cutting them down to the maximum limit in the higher wage groups. If the statistics of wages by groups is sufficiently detailed, the mean wage of each group may be safely accepted as the average. When these computations are made a comparison of the total benefits which would be payable to the entire group without any limits, and the benefits actually payable with due consideration to the limits, would indicate the measure of influence of the weekly benefit limits, which may be an additional charge in some cases or a discount in others.

The greatest difficulty in applying this method is in obtaining necessary data as to the wage distribution of injured persons in various states. Such data are gradually being furnished by the Workmen's Compensation Commissions or Boards which report statistics of accidents according to the wages of the injured as well as in a great many other ways.

In other cases special investigations may be found in the reports of respective bureaus of labor statistics. It is believed that such data are available at present for a few states, as Massachusetts, Minnesota, Illinois, California, and others. In a case of adjoining states, it may be safe to assume the wage scale to be fairly uniform throughout the larger territory.

In general, the effect of the lower limit is to increase the cost of compensation and the effect of the maximum limit is naturally in the opposite direction. The effect of the two limits being contrary to each other, the results seldom indicate any very large correction for limits, at least as far as weekly benefits are concerned. With the 50 per cent. benefit scale it will be found that the minimum limit has greater importance in increasing the benefits than the maximum limit in reducing them, and therefore as a rule it may be said that in states having a 50 per cent. benefit scale the results of the limits will be an additional charge upon the cost of compensation. On the other hand, where the scale of compensation is two thirds or anywhere near it, comparatively few cases fall below the minimum limit, while the maximum may decrease the cost in a great many cases. As a result a cheapening of the cost is sometimes produced by low limits when a two thirds scale of compensation obtains. Thus, for instance, a \$10 maximum limit is of very little effect in reducing the cost where the benefit scale is 50 per cent., but it does effect a substantial saving on a two thirds benefit scale.

More complicated are the problems created by the maximum limits established in the acts for the total amount of compensation payable, which apply particularly to cases of death and permanent disability, when the money limit is such as to cut down the period for which benefits may be paid, in all cases where the weekly benefit is a little larger than usual. In other words, the money limit reduces the number of weeks for which compensation may be paid in certain cases, the effect of the money limit depending largely upon the wages. It is evident that the final effect of such maximum money limits depends upon the number of cases which will be affected thereby. In other words, it depends largely upon wage distribution. In order to ascertain, therefore, the effect of such

money limits, it may be necessary to distribute the total number of cases subject to the provision by wage groups, compute the cost of all cases both with and without consideration to the maximum limits, and in that way give proper weight to the effect of the limits which may be exercised in only a few of the cases.

Finally, after the cost of compensation payable in the hundred thousand accidents is computed, the question of the cost of medical benefit remains. It is readily admitted that while the cost of medical and surgical aid represents a very substantial part of the total cost of compensation, it is very difficult to estimate such cost from the provisions in the acts themselves, and therefore it is impossible to apply the standard table method for ascertaining the cost of medical benefits. It seems that for this part of the cost it is necessary to revert to direct experience. For Massachusetts and one or two other states a certain amount of experience is available which indicates the proportion between the cost of compensation and the cost of medical aid, and the proportion may be utilized to load the cost of the hundred thousand accidents as ascertained above by the proper percentage for medical aid. It is true that the provisions for medical aid are subject to some variations between states, and nothing better than an estimate by judgment as to the value of the differences in the provisions of one act and the other, can be suggested here. Fortunately, however, the difference in provisions for medical aid is not so great as that for other features of compensation acts, and any possible errors would not greatly affect the final results.

The methods which may be used in computing the comparative cost of different compensation acts by comparing the cost of the hundred thousand accidents in different states, have been described here in sufficient detail to enable independent students of the problem to apply them. Theoretically all students should get exactly the identical result while working independently. As a practical matter it is hardly fair to expect that, because inevitably some little differences of judgment may arise. There is, therefore, no intention to claim that all the details of the method presented here are infallible. There can be little doubt that the actual experience of com-

pensation insurance in this country, after sufficient time has elapsed to permit its careful study, may introduce some corrections in the table itself or in the results as obtained from the table. There may be differences in interpretation of the law in different states, which are not evident in the language of the acts themselves, and when the problem is to ascertain the comparative cost of the Compensation Law before it has even gone into force, it is evident that no account can be taken of such differences of application of law. Since the Standard Accident Table depends upon an assumption of a fairly well distributed industry, it is possible that in some states in which certain industries predominate, they may affect the Standard Table itself. These and other qualifications must be kept in mind when applying the Standard Table or the methods as indicated here. The eventual accuracy of the results will depend upon the development of proper accident statistics in this country, but the claim is made for the table and the method as outlined here that in the absence of more accurate statistical data, it is the only one by means of which proper actuarial work in connection with compensation problems can be carried on at the present time.